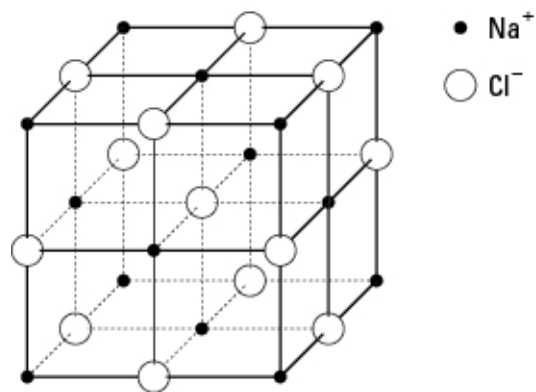
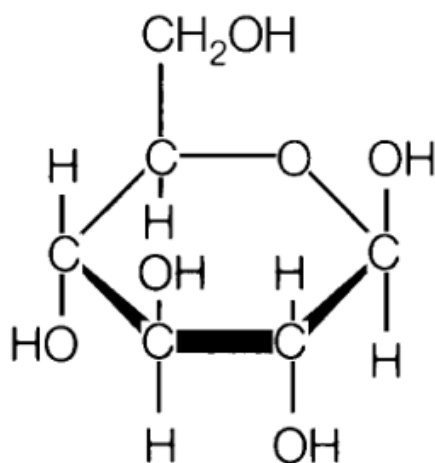


Chemistry I

Final Examination Reference Materials



DO NOT WRITE IN THIS BOOKLET

Miscellaneous

1 mole = 6.02×10^{23} representative particles

1 mole = 22.4 liters (gas at STP)

1 mole = molar mass

$$\% \text{ Error} = \left(\frac{|\text{experimental value} - \text{accepted value}|}{\text{accepted value}} \right) \times 100$$

$$\% \text{ yield} = \left(\frac{\text{actual mass of product}}{\text{predicted mass of product}} \right) \times 100$$

Celsius + 273 = Kelvin

1 atm = 760 mmHg = 760 torr = 101.3 kPa = 14.7 psi

1 Liter = 1000 milliliters

1 milliliter = 1 cm^3

$$\# \text{ mol} = \frac{\# \text{ g}}{\text{mm}}$$

$$\# \text{ L} = \frac{\# \text{ mL}}{1000}$$

$$\# \text{ kg} = \frac{\# \text{ g}}{1000}$$

Equivalent Units of Standard Pressure:

1 atmosphere (atm)	14.7 lbs/ in ²	101.33 kPa
760 mm of Hg	760 Torr	1013.25 millibars
29.92 inches of Hg	0.760 meters of Hg	76 cm of Hg

Gas Laws

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $P_1V_1 = P_2V_2$	$PV = \frac{gRT}{MW}$ $PV = nRT$
$\frac{(P_1V_1)}{T_1} = \frac{(P_2V_2)}{T_2}$ $\frac{V_1}{n_1} = \frac{V_2}{n_2}$	
$d = \frac{(P)(mm)}{(R)(T)}$	$\frac{R_a}{R_b} = \frac{\sqrt{mw_b}}{\sqrt{mw_a}}$

Selected Universal Gas Constants (R):

Values of <i>R</i>	Units $\frac{P-V}{T-n}$
0.0820	$\frac{L-atm}{K-mol}$
82.05	$\frac{mL-atm}{K-mol}$
62.36	$\frac{L-mmHg}{K-mol}$
62363.6	$\frac{mL-mmHg}{K-mol}$
62.36	$\frac{L-Torr}{K-mol}$

Vapor Pressure of Water at Various Temperatures

Temp (°C)	Pressure		
	mm Hg	atm	kPa
0	4.6	0.006	0.61
5	6.5	0.009	0.87
10	9.2	0.012	1.23
15	12.8	0.017	1.70
16	13.6	0.018	1.82
17	14.5	0.019	1.94
18	15.5	0.020	2.06
19	16.5	0.022	2.20
20	17.5	0.023	2.34
21	18.6	0.025	2.49
22	19.8	0.026	2.64
23	21.1	0.028	2.81
24	22.4	0.029	2.98
25	23.8	0.031	3.17
26	25.2	0.033	3.36
27	26.7	0.035	3.56
28	28.3	0.037	3.78
29	30.0	0.040	4.00
30	31.8	0.042	4.24
31	33.7	0.044	4.49
32	35.7	0.047	4.76
33	37.7	0.050	5.03
34	39.9	0.053	5.32
35	42.2	0.056	5.62
36	44.6	0.059	5.94
37	47.1	0.062	6.28
38	49.7	0.065	6.62
39	52.4	0.069	6.99
40	55.3	0.073	7.38
45	71.9	0.095	9.58
50	92.5	0.122	12.33
55	118.0	0.1553	15.74
60	149.4	0.1965	19.92
65	187.5	0.247	25.00
70	233.7	0.308	31.16
75	289.1	0.380	38.54
80	355.1	0.467	47.34
85	433.6	0.571	57.81
90	525.8	0.692	70.09
95	633.9	0.834	84.51
100	760.0	1.00	101.33

Solutions

Percent Concentration by mass

$$\% \text{ solute} = \frac{\#g \text{ solute}}{\#g \text{ solution}} \times 100\% \qquad \% \text{ solute} = \frac{\#g \text{ solvent}}{(\#g \text{ solution} + \#g \text{ solvent})} \times 100\%$$

Molarity

$$M = \frac{\text{mol.}(\text{solute})}{L(\text{solution})} \qquad M = \frac{\left(\frac{\#g}{\text{mm}}\right)}{L(\text{solution})}$$

Molality

$$m = \frac{\text{mol.}(\text{solute})}{\text{kg}(\text{solvent})} \qquad m = \frac{\left(\frac{\#g}{\text{mm}}\right)}{\text{kg}(\text{solvent})}$$

Henry's Law

$$\frac{C_1}{P_1} = \frac{C_2}{P_2}$$

Freezing point & boiling point for water

$$\Delta T_f = (m) \left(\frac{1.86^\circ \text{C}}{1 \text{ m}} \right) (\# \text{ particles}) \qquad \Delta T_b = (m) \left(\frac{0.512^\circ \text{C}}{1 \text{ m}} \right) (\# \text{ particles})$$

$$\text{fp}_{\text{new}} = \text{fp}_{\text{original}} - \Delta T_f$$

$$\text{bp}_{\text{new}} = \text{bp}_{\text{original}} + \Delta T_b$$

pH & pOH

$$\begin{array}{lll} \text{pH} = -\log[H^+] & [H^+] = 10^{-\text{pH}} & \text{pH} + \text{pOH} = 14 \\ [H^+][OH^-] = 10^{-14} & \text{pOH} = -\log[OH^-] & [OH^-] = 10^{-\text{pOH}} \end{array}$$

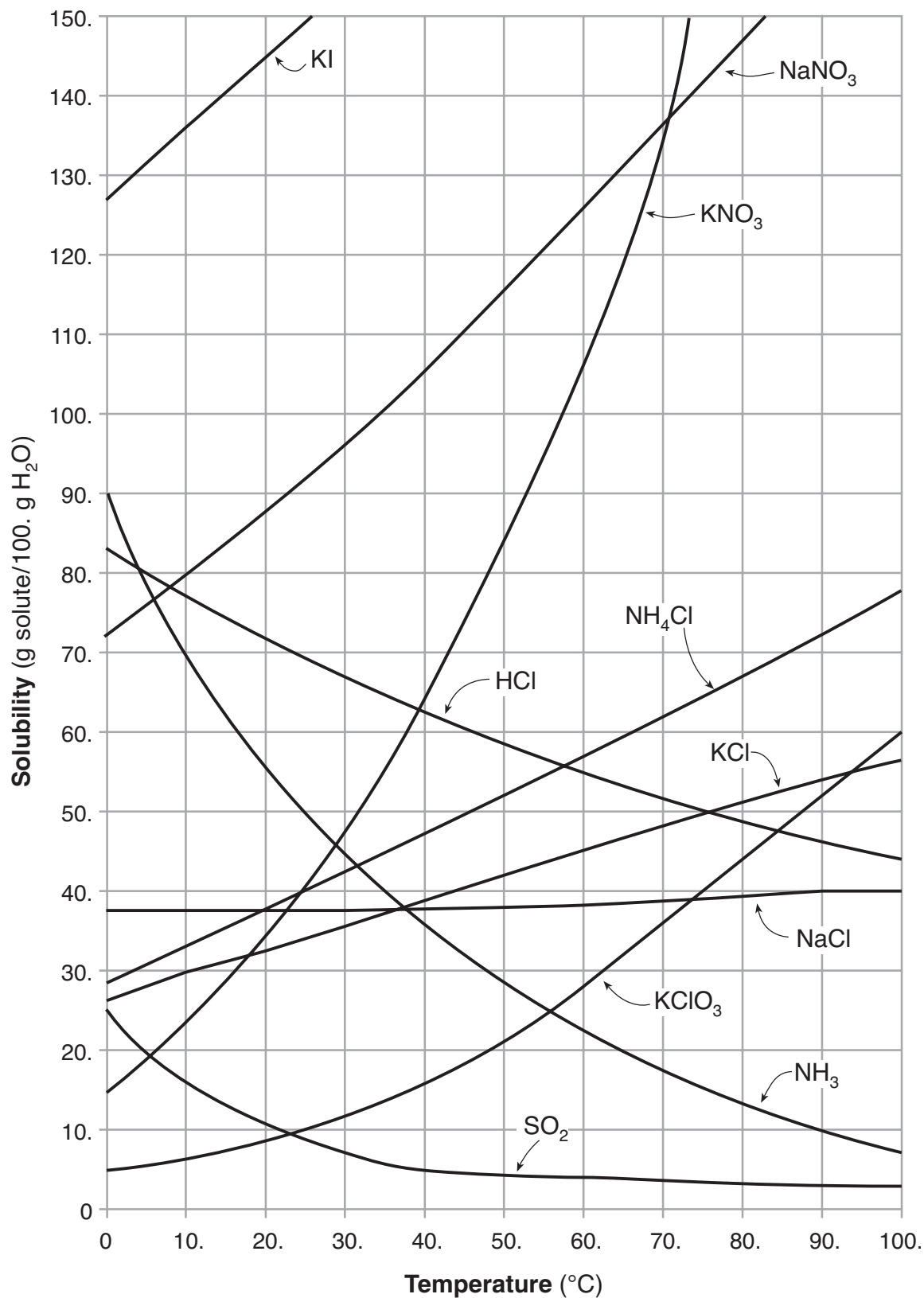
Titration: Stoichiometric approach:

$$(\#H's)(M_{\text{acid}})(\text{volume}_{\text{acid}}) = (\#OH's)(M_{\text{base}})(\text{volume}_{\text{base}})$$

Rules for assigning oxidation numbers.

1. 1. The algebraic sum of the oxidation numbers of ALL of the atoms in a compound MUST equal zero.
2. An uncombined element (free element) has an oxidation number of zero (0).
3. A monatomic ion has an oxidation number equal to its charge.
4. Fluorine's oxidation number is -1 in all compounds.
5. Oxygen has an oxidation number of -2 in all compounds.
6. Hydrogen has an oxidation number of $+1$ except when combined with metals.
7. All Group 1 elements will have a $+1$ oxidation number. All Group 2 elements have a $+2$ oxidation number. Aluminum will always be $+3$.
8. Second element in a binary compound is assigned the oxidation number it would have if it were an ion.
9. The algebraic sum of the oxidation numbers of ALL atoms in a polyatomic ion is equal to the charge of the ion.

Table G
Solubility Curves at Standard Pressure



The Modern Periodic Table of the Elements

1

±1

H

Hydrogen

1.0

2

3

+1

Li

Lithium

6.9

4

+2

Be

Beryllium

9.0

11

+1

Na

Sodium

23.0

12

+2

Mg

Magnesium

24.3

19

+1

K

Potassium

39.1

20

+2

Ca

Calcium

40.1

21

+3

Sc

Scandium

45.0

22

+3

+4

Ti

Titanium

47.9

23

+2

+5

V

Vanadium

50.9

24

+2

+3

Cr

Chromium

52.0

25

+2

+7

Mn

Manganese

54.9

26

+3

+2

Fe

Iron

55.8

27

+2

+3

Co

Cobalt

58.9

28

+2

+3

Ni

Nickel

58.7

29

+1

+2

Cu

Copper

63.5

30

+2

Zn

Zinc

65.4

37

+1

Rb

Rubidium

85.5

38

+2

Sr

Strontium

87.6

39

+3

Y

Yttrium

88.9

40

+4

Zr

Zirconium

91.2

41

+5

+3

Nb

Niobium

92.9

42

+6

+2

Mo

Molybdenum

95.9

43

+7

+3

Tc

Technetium

(99)

44

+3

Ru

Ruthenium

101.1

45

+3

Rh

Rhodium

102.9

46

+2

+3

Pd

Palladium

106.4

47

+1

Ag

Silver

107.9

48

+3

Cd

Cadmium

112.4

49

+3

+1

In

Indium

114.8

50

+2

+4

Sn

Tin

118.7

51

−3

+5

Sb

Antimony

121.8

52

−2

+4

Te

Tellurium

127.6

53

−1

I

Iodine

126.9

54

Xe

Xenon

131.3

55

+1

Cs

Cesium

132.9

56

+2

Ba

Barium

137.3

57

+3

La

Lanthanum

138.9

72

+4

Hf

Hafnium

178.5

73

+5

Ta

Tantalum

180.9

74

+6

+2

W

Tungsten

183.9

75

+7

+3

Re

Rhenium

186.2

76

+2

+3

Os

Osmium

190.2

77

+2

+3

Ir

Iridium

192.2

78

+2

+4

Pt

Platinum

195.1

79

+1

+3

Au

Gold

197.0

80

+1

+2

Hg

Mercury

200.6

81

+1

+3

Tl

Thallium

204.4

82

+2

+4

Pb

Lead

207.2

83

−3

+5

Bi

Bismuth

209.0

84

±2

+4

Po

Polonium

(209)

85

−1

At

Astatine

(210)

86

Rn

Radon

(222)

87

+1

Fr

Francium

(223)†

88

+2

Ra

Radium

(226)

89

+3

Ac

Actinium

(227)

18

2

He

Helium

4.0

13

5

+3

B

Boron

10.8

14

6

+4

+2

C

Carbon

12.0

15

7

−3

+5

N

Nitrogen

14.0

16

8

−2

O

Oxygen

16.0

17

9

−1

F

Fluorine

19.0

18

10

Ne

Neon

20.2

13

13

+3

Al

Aluminum

27.0

14

14

+4

+2

Si

Silicon

28.1

15

15

−3

P

Phosphorus

31.0

16

16

−2

+4

S

Sulphur

32.1

17

17

−1

Cl

Chlorine

35.5

18

18

Ar

Argon

40.0

31

+3

Ga

Gallium

69.7

32

+4

+2

Ge

Germanium

72.6

33

−3

+5

As

Arsenic

74.9

34

−2

+4

Se

Selenium

79.0

35

−1

Br

Bromine

79.9

36

Kr

Krypton

83.8

49

+3

+1

In

Indium

114.8

50

+2

+4

Sn

Tin

118.7

51

−3

+5

Sb

Antimony

121.8

52

−2

+4

Te

Tellurium

127.6

53

−1

I

Iodine

126.9

54

Xe

Xenon

131.3

81

+1

+3

Tl

Thallium

204.4

82

+2

+4

Pb

Lead

207.2

83

−3

+5

Bi

Bismuth

209.0

84

±2

+4

Po

Polonium

(209)

85

−1

At

Astatine

(210)

86

Rn

Radon

(222)

1

±1

H

Hydrogen

1.0

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

6

+4

+2

Symbol → C

Carbon

12.0

↑

Atomic mass*

*Based on C¹² = 12.00000

Atomic number →

Combining capacity

LANTHANIDE SERIES

58

+3

+4

Ce

Cerium

140.1

59

+3

+4

Pr

Praseodymium

140.9

60

+3

Nd

Neodymium

144.2

61

+3

Pm

Promethium

(145)

62

+2

+3

Sm

Samarium

150.4

63

+2

+3

Eu

Europium

152.0

64

+3

Gd

Gadolinium

157.3

65

+3

+4

Tb

Terbium

158.9

66

+3

Dy

Dysprosium

162.5

67

+3

Ho

Holmium

164.9

68

+3

Er

Erbium

167.3

69

−2

−3

Tm

Thulium

168.9

70

−2

−3

Yb

Ytterbium

173.0

71

−3

Lu

Lutetium

175.0

ACTINIDE SERIES

90

+4

Th

Thorium

232.0

91

+4

+5

Pa

Protactinium

(231)

92

+3

+4

U

Uranium

238.0

93

+3

+4

Np

Neptunium

(244)

94

+3

+4

Pu

Plutonium

(244)

95

+3

+4

Am

Americium

(243)

96

+3

Cm

Curium

(247)

97

+3

+4

Bk

Berkelium

(247)

98

Cf

Californium

(251)

99

Es

Einsteinium

(252)

100

Fm

Fermium

(257)

101

Md

Mendelevium

(258)

102

No

Nobelium

(259)

103

Lr

Lawrencium

(260)

†Masses in parentheses are the mass numbers of the most stable isotope.

†Masses in parentheses are the mass numbers of the most stable isotope.